

What is claimed is:

- 1 1. A mode converter comprising a silicon waveguide core deposited over a first silicon  
2 dioxide cladding layer, the silicon waveguide core polished such that a first end of the silicon  
3 waveguide core has a larger cross-sectional area than a second end of the silicon waveguide  
4 core.
- 1 2. The mode converter of claim 1, wherein the silicon waveguide core comprises a  
2 vertical taper.
- 1 3. The mode converter of claim 1, wherein the silicon waveguide core comprises a  
2 lateral taper.
- 1 4. The mode converter of claim 2, wherein the silicon waveguide core comprises an  
2 angled top surface and a flat bottom surface.
- 1 5. The mode converter of claim 3, wherein the slope of the vertical taper matches the  
2 slope of the lateral taper.
- 1 6. The mode converter of claim 1 further comprising a second silicon dioxide cladding  
2 layer deposited over the silicon waveguide core to provide a symmetric clad.
- 1 7. The mode converter of claim 1 further comprising a silicon substrate, wherein the first  
2 silicon dioxide cladding layer and the silicon waveguide core are formed over the silicon  
3 substrate.
- 1 8. The mode converter of claim 1, wherein the second end of the silicon waveguide core  
2 has at least one dimension of about 1  $\mu\text{m}$ .
- 1 9. A method of forming a mode converter comprising:  
2 depositing a silicon waveguide core over a first silicon dioxide cladding layer; and

3           polishing the silicon waveguide core such that a first end of the silicon waveguide  
4   core has a larger cross-sectional area than a second end of the silicon waveguide core.

1   10.    The method of claim 9, wherein the polishing step includes vertically tapering the  
2   silicon waveguide core.

1   11.    The method of claim 9 further comprising tapering the silicon waveguide core  
2   laterally using a lithographic mask and etch process.

1   12.    The method of claim 10, wherein the silicon waveguide core comprises an angled top  
2   surface and a flat bottom surface.

1   13.    The method of claim 11 further comprising matching the slope of the vertical taper to  
2   the slope of the lateral taper.

1   14.    The method of claim 9 further comprising depositing a second silicon dioxide  
2   cladding layer over the silicon waveguide core to provide a symmetric clad.

1   15.    The method of claim 9 further comprising forming the first silicon dioxide cladding  
2   layer and the silicon waveguide core over a silicon substrate.

1   16.    The method of claim 9 further comprising mode matching the first end to a single  
2   mode fiber.

1   17.    The method of claim 9 further comprising mode matching the second end to one of a  
2   group consisting of a waveguide device and a semiconductor laser.

1   18.    A mode converter comprising a silicon waveguide core deposited over a first silicon  
2   dioxide cladding layer, the silicon waveguide core being tapered using a gray-scale

3 lithographic mask and etch process such that a first end of the silicon waveguide core has a  
4 larger cross-sectional area than a second end of the silicon waveguide core.

1 19. The mode converter of claim 18, wherein the silicon waveguide core comprises a  
2 vertical taper.

1 20. The mode converter of claim 19, wherein the silicon waveguide core comprises a  
2 lateral taper.

1 21. The mode converter of claim 20, wherein the slope of the vertical taper matches the  
2 slope of the lateral taper.

1 22. The mode converter of claim 18 further comprising a second silicon dioxide cladding  
2 layer deposited over the silicon waveguide core to provide a symmetric clad.

1 23. The mode converter of claim 18 further comprising the first silicon dioxide cladding  
2 layer and the silicon waveguide core formed over a silicon substrate.

1 24. The mode converter of claim 18, wherein the second end of the silicon waveguide  
2 core has at least one dimension of about 0.25  $\mu\text{m}$ .

1 25. A method of forming a mode converter, the method comprising:  
2 depositing a silicon waveguide core over a first silicon dioxide cladding layer; and  
3 using a gray-scale lithographic mask and etch process on the silicon waveguide core  
4 such that a first end of the silicon waveguide core has a larger cross-sectional area than a  
5 second end of the silicon waveguide core.

1 26. The method of claim 25 further comprising vertically tapering the silicon waveguide  
2 core using the gray-scale lithographic mask and etch process.

1 27. The method of claim 26 further comprising laterally taper the silicon waveguide core  
2 using the gray-scale lithographic mask and etch process.

1 28. The method of claim 27 further comprising matching the slope of the vertical taper to  
2 the slope of the lateral taper.

1 29. The method of claim 25 further comprising depositing a second silicon dioxide  
2 cladding layer over the silicon waveguide core to provide a symmetric clad.

1 30. The method of claim 25 further comprising forming the first silicon dioxide cladding  
2 layer and the silicon waveguide core over a silicon substrate.

1 31. The method of claim 25 further comprising mode matching the first end to a single  
2 mode fiber.

1 32. The method of claim 25 further comprising mode matching the second end to one of a  
2 group consisting of a waveguide device and a semiconductor laser.